MISSOURI DEPARTMENT OF NATURAL RESOURCES

Cool-Season Grass Stand Management on Reclaimed Minelands - Landowner Management Guide

Fact Sheet
8/2000

Division of Environmental Quality
Land Reclamation Program

Cool-Season Grass Stand Management on Reclaimed Minelands

This handout is designed to assist landowners of reclaimed mines sites that have been revegetated with cool-season grasses and legumes. Landowners must be aware that poor management practices can ruin a cool-season grass stand. Reclaimed sites are very fragile systems that are susceptible to overgrazing and droughty soils which may cause stand failure. When a stand fails, the soil may erode. This can expose toxic material, which will kill vegetation and move into lakes and streams causing water pollution. To avoid catastrophic stand failures, these sites require special care and attention to management practices. A reclaimed site takes years to develop the soil fertility and structure necessary to maintain a productive grass stand under correct management. It requires continual inputs of organic matter and the passage of time to create a soil system of organisms, structure and chemistry to sustain an intensively managed grass stand. Poor management can destroy reclaimed mine land in a matter of days.

Cool Season Grasses

Cool-season grasses achieve maximum growth and development from March to June and again from September to November over much of Missouri. Growth is greatly reduced in the hot, dry summer months. Most cool-season grasses have relatively shallow root systems that are unable to tap moisture deep in the soil. During extended dry spells, leaves of cool-season grasses stop photosynthesizing, turn brown and die to reduce water loss. This dormancy period allows many species of cool-season grasses to survive drought conditions. Cool-season grasses do not provide forage during dormant periods. Tall fescue, bluegrass, orchard grass, timothy, smooth brome and perennial ryegrass are examples of cool-season grass species.

Cool-season grasses have many advantages. Generally, they are easily and quickly established. They green up early in the spring and, after summer dormancy, green up again in the fall. Most species growing in **good soil** can withstand heavy grazing and haying, though substantial fertilizer treatments are necessary to maintain productivity. A cool-season grass stand can produce a substantial amount of forage, but quality depends on the maturity of the stand and the species in the mixture. The quantity and quality of forage grown on mine soils may be much less than that produced on an equal acreage of native soils.

Legumes play a significant role in the success of cool-season grass seeding mixtures on reclaimed minelands. With the aid of bacteria, these highly nutritious plants gather nitrogen from the air and utilize it for plant growth. This enriches the nitrogen level of the soil and saves on fertilizer costs. Grasses use nitrogen added to the soil by legumes, making them less dependent upon chemical fertilizers. Similar to the grasses, some legume species are cool-season plants while others grow best in the warm-season. Red clover, white clover, sweet clover and

PUB001095

hairy vetch are cool-season legumes. Lespedeza, alfalfa and birdsfoot trefoil are warm-season legumes. Alfalfa grows best on deep, well-drained soils that are moist during warm growing conditions. In most situations, it is best to plant cool-season legumes with cool-season grasses to maximize the quantity and quality of forage production. Legumes greatly add to the nutrient value of hay. However, under intense grazing or haying, legumes die out from the stand in a few years. Grass sods should be reseeded or renovated every three to four years with legumes to maintain forage quality.

Soils and Reclamation

On reclamation sites, the soil has a naturally low fertility level and poor water-holding capacity. Much of this is due to the extremely low levels of organic matter present in newly reclaimed mine soils and from compaction caused by earth moving equipment. Organic matter in the form of dead leaves, stems and roots in a productive soil creates a protective mulch that reduces soil erosion and water evaporation. Organic matter acts as a sponge that absorbs and holds nutrients and water in the soil for plant use. Decomposed organic matter called humus binds soil nutrients to its surface. Nutrients are slowly released by the humus particles in the soil, which can then be absorbed by plant roots. Without humus, soil nutrients added by fertilizing are quickly leached out of the rooting zone before the plants have the opportunity to use them. Soil organic matter also feeds beneficial soil organisms that break down humus and release soil nutrients, especially nitrogen and phosphorus. Once organic matter and soil organisms are present in the mine soil, nutrients can by cycled from dead plants to humus, then from humus to living plants to begin the process again. This process is called nutrient cycling. The more organic matter produced, the more nutrients are stored by the humus and clay particles until an equilibrium is reached. The higher the level of nutrients present in the soil, the more productive the soil will be. Productivity on reclaimed mine soils is directly related to the amount of organic matter present and the amount of nutrients being cycled in the soil.

The movement of heavy equipment compacts reclamation soils, which inhibits root growth and reduces the soil's water-holding capacity and infiltration rate. Over time, roots and fungi penetrate the soil and increase the number and size of soil voids, or pore space. This action reduces soil compaction and increases the water-holding capacity of the soil. Soil organisms like earthworms burrow through the soil, further decreasing soil compaction and converting fresh organic matter into nutrients available to plants. Finally, freezing and thawing, and wetting and drying cycles through the seasons physically break up the compacted soil over a period of many years. This requires time and protection from livestock and vehicles to prevent compaction and vegetation loss that lead to erosion. Native soils have undergone these processes for thousands of years, unlike mine soils that have been created in months or years.

Cool-Season Grass Management

If the landowner can allow a reclaimed site to lie fallow, the eventual productivity of the soil will be greatly increased as the amount of organic matter is increased. At least three years should elapse after initial seeding before a light haying or grazing reduces the amount of organic matter being added to the soil. A reclamation project site cannot be expected to produce as much forage as an adjacent unmined native soil. Reclamation soils are marginally productive in the short term, and heavy grazing or haying robs future productivity. Time must pass before a productive soil can develop under the harsh conditions.

Cool-season grass stands on reclaimed land should be managed carefully to avoid a stand failure. This requires timely soil tests and proper topdressing with fertilizer and lime. Pastures on reclaimed sites require more extensive soil management plans and monitoring than undisturbed pastures. The county extension office, the USDA Natural Resource Conservation Service

or the Land Reclamation Program can assist landowners with soil testing, analysis and pasture management practices.

Three years after initial seeding, a cool-season grass stand should be renovated with legumes. The grass sod should be lightly disced and legume seed drilled into the soil. This practice improves the quality of the stand and reduces the amount of fertilizer needed. Nitrogen fertilizer should not be used in renovating grass sods with legumes. Legumes provide their own nitrogen and, therefore, do not need nitrogen fertilizer. Grasses out-compete legumes when nitrogen is applied, resulting in rapid decline of the legumes. Phosphorus and potassium are important for legume maintenance, so periodic soil tests should be taken. It is essential that adequate lime and fertilizer be applied, since the natural fertility on mine soils is low. Landowners should send soil samples to local extension agents for fertility recommendations.

Grazing and Haying Cool-Season Grasses

Cool-season grasses should never be grazed or cut closer than four inches, and 30 days should pass between grazing or haying to allow the stand to recover. Grazing and haying should be stopped from mid-June through August during the cool-season grass dormant period. Thirty days from the first frost, the stand should be left fallow to carry the plants over the winter. This period allows the plants to produce and store enough food in the roots for early spring green-up. Early grazing or haying in late winter or early spring is necessary to prevent the grasses from overtopping the legumes, but legumes should not be grazed closer than four inches.

Ultimately, under the best management, legumes will disappear from the stand and require reseeding into the grass sod every three to four years. First, lightly disc the sod, then drill-seed the legume into the soil. A poorly managed stand may lose all legumes in the first month of haying or grazing.

Excessive or poorly timed grazing or haying will remove legumes and grasses, leaving bare spots that are susceptible to erosion and invasion by weeds. Erosion of mine lands could expose acid-producing materials that are toxic to plants and may cause water pollution. Proper management must include annual soil testing and topdressing of lime and fertilizer to maintain the stand productivity. Mine soils are low in organic matter and natural fertility and have a greater need for lime and fertilizer than surrounding pastures.

For further information, please contact your district soil conservationist of the Soil Conservation Service or your local University of Missouri extension agent. For wildlife concerns, please contact the Missouri Department of Conservation. For specific problems with the reclamation site, contact the Department of Natural Resources' Land Reclamation Program.

Cool Season Grasses in Extremely Acid Mine Soils

In certain locations in Missouri, the minespoils are extremely acidic due to high levels of iron sulfide or pyrite. Lime must be periodically added to prevent stand failure. Introduced, cool-season grass and legume species cannot survive these acid conditions. The Land Reclamation Program can assist landowners in determining an effective lime requirement.

Cool Season Grasses Landowner's Checklist

To maintain a productive grass-legume stand on a reclamation project and to protect the site from erosion, the landowner SHOULD:

- allow the stand to grow and develop for at least two years after establishment before haying or grazing.

- graze or hay lightly, since the mine soil cannot sustain a stand under heavy management pressure.

- take regular soil tests and amend the soil, especially bare areas, with lime and fertilizer according to those test results. Remember, soil tests were designed for predicting fertilizer requirements for native soils. Use test results only as a rough guide for mine soils.

- encourage the accumulation of organic matter since it increases soil productivity, water-holding capacity, improves soil structure and reduces erosion. It also supports beneficial soil organisms.

- seed legumes into the sod to improve the forage quality of the stand and to reduce fertilizer needs.

- rotationally graze the stand three to four years after establishment, moving livestock before the grass is cut shorter than four inches, not allowing livestock back for 30 days.

- closely monitor the site, looking for bare spots and evidence of erosion.

- repair erosion problems or address bare spots as needed.

- The Landowner <u>SHOULD NOT:</u>

- graze or hay the site for at least two years after establishment.

- graze or hay the site shorter than four inches.

- graze or hay earlier than 30 days after the previous cutting.

- allow cattle or vehicles on the site during muddy conditions.

- expect a reclaimed site pasture to be as productive as an undisturbed pasture.

The landowner must be aware that reclaimed soils need time to develop and become productive. Poor management can quickly ruin an area, leaving behind a lifeless and potentially toxic site, undoing all the environmental benefits of the reclamation project.

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